Space Weather Technical Forecast

Issued on Wednesday, 25 May 2022 at 13:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low during the last 24 hours with only C-class flare activity observed, mainly from AR3017 (Dsi/Beta-delta) and AR3014 (Dkc/Beta-gamma-delta) both in the northwest quadrant. A C5.1 flare was observed at 24/2217 UTC from the new region AR3023 (Dsc/Beta-delta) that has rotated over the eastern limb in the past 24-hours. The remaining five regions are all small and currently benign. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind at L1, measured by ACE and DSCOVR has been steady at background levels, just below 400km/s. Density has been mainly below average. The total magnetic field strength (IMF, Bt) was weak, but briefly moderate reaching 9nT, with the north-south component, Bz, only varying weakly between 6nT and -6nT. The Phi angle has mainly been in the positive (away from the Sun) sector. Total geomagnetic activity was Quiet to Unsettled throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has mainly been at moderate levels, with a peak value of 968pfu at 24/1710UTC. Corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a rising then level trend to reach 4.80e7 integrated pfu at 25/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, but with a chance of Moderate activity and a very slight chance of High activity. This is due to three moderately large and complex regions; two in the northwestern quadrant and one near the eastern limb.

Solar Wind / Geomagnetic Activity: No CMEs are currently on the Earth-Sun line. Solar winds are expected to rise from background to elevated on day 2 and into day 3 (26th and 27th) due to the arrival of the fast wind of CH84/-, perhaps preceded by CH85/-. Geomagnetic activity is expected to be Quiet at first, increasing to Unsettled to Active with a slight chance of G1/Minor Storms day 2 and into day 3 (26th and 27th). Geomagnetic activity should return to Quiet or Unsettled levels by Day 4 (28th).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, with a slight chance of reaching S1/Minor Storm levels. High energy electron flux (greater than 2MeV) is expected to fall to background levels by day 2 (26th). Electron flux should rise on Day 4 (28th) possibly reaching High levels. Electron fluence is forecast to follow a declining trend for the next 2-3 days, remaining below the Active threshold, then with a slight rise possible on Day 4.

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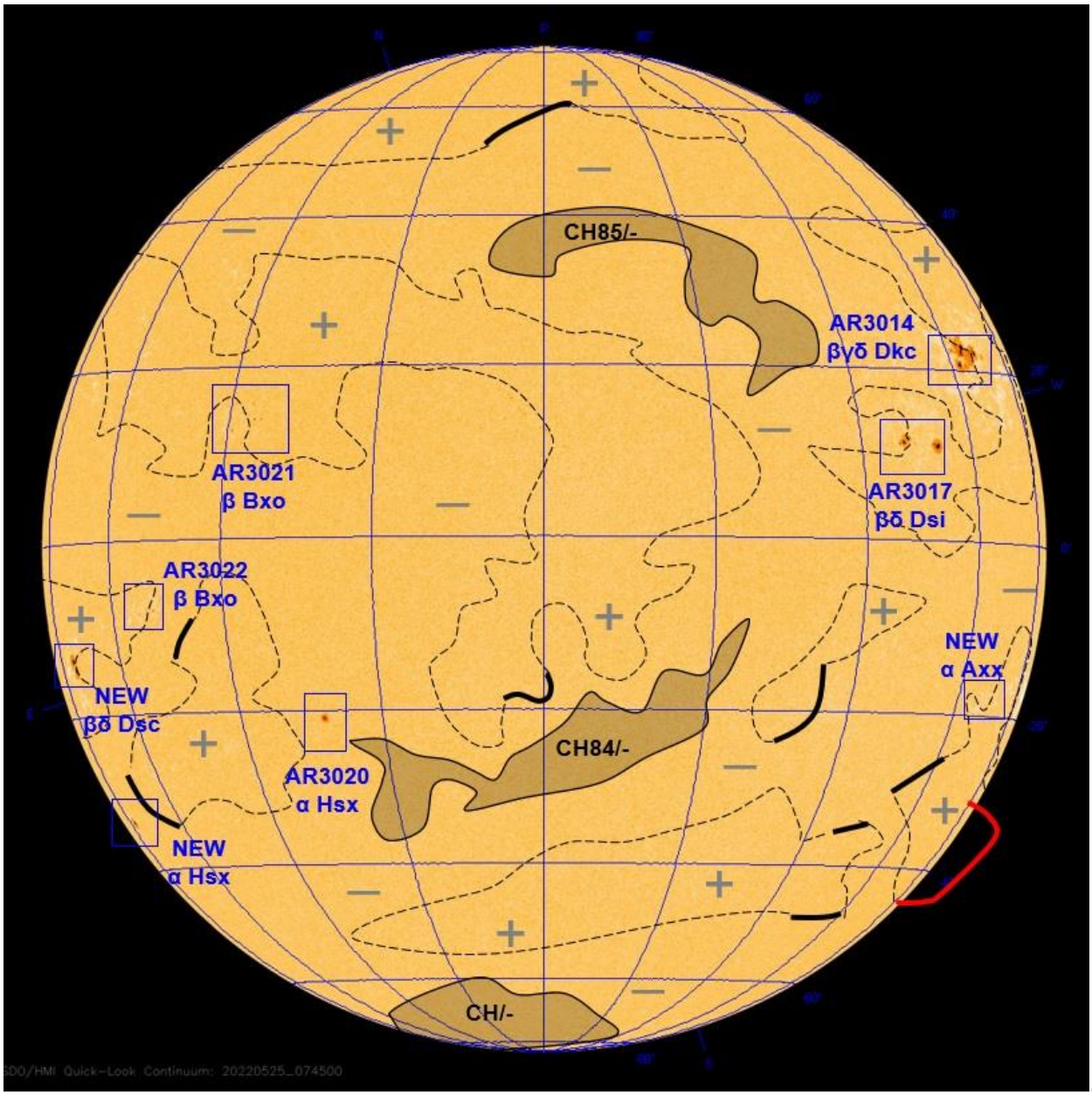
Figure 1. Solar Analysis Valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

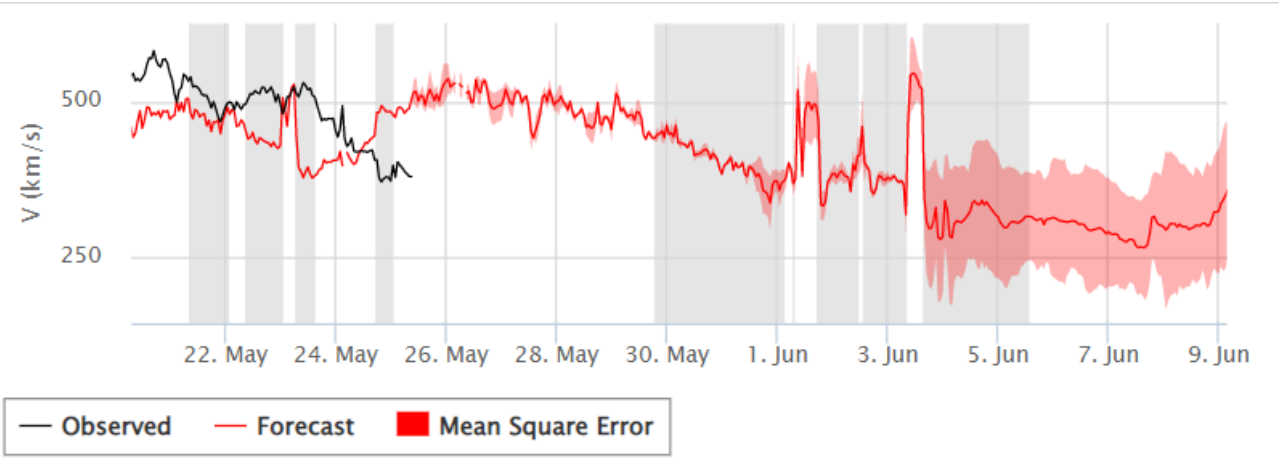
There are no Earth-directed CMEs currently in the forecast.

Solar wind speeds are expected to persist at background levels at first day 1 (25th), before becoming enhanced through day 2 (26th) due to the arrival of the fast wind of CH84/- in the southern hemisphere, potentially preceded by the arrival of the fast wind of CH85/- in the northern hemisphere, although this is low confidence as a new feature on this rotation. CH84 is a persistent feature which produced winds of 500-550km/s (elevated) on the last rotation, and perhaps slightly stronger on this occasion.

Geomagnetic activity is expected to be Quiet on Day 1 (25th), with an increasing risk of Active intervals due to any connection with Coronal Hole 84 or 85 on Day 2 (26th) and perhaps early Day 3 (27th), with a slight chance of G1/Minor Storms. Geomagnetic activity should return to Quiet or Unsettled levels by Day 4 (28th May).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	20	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Wind Persistence Model



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Radio Blackouts - X-Ray Flares:

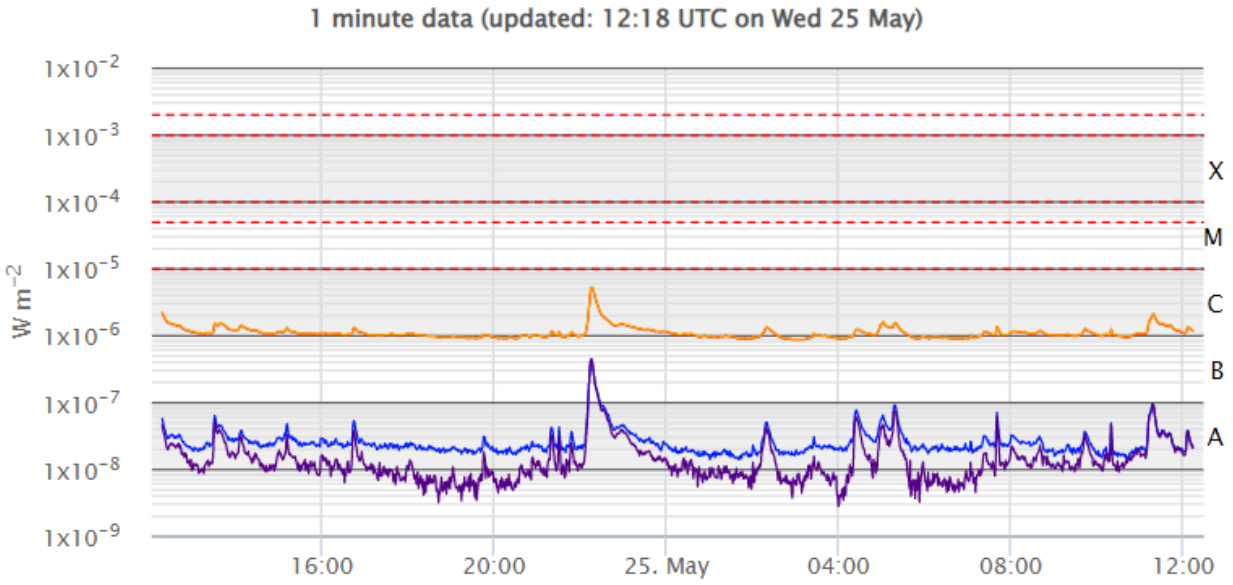
Solar Activity is currently Low with the largest flare observed a C5.1 at 24/2217 UTC from AR2023 (Dsc/Beta-Delta) near the southeast limb. This sunspot region is significantly foreshortened in available coronagraph imagery, so further analysis is required once it rotates into clearer view, to confirm the magnetic configuration of the group.

Historically, AR3014 (Dkc/Beta-Gamma-Delta) and AR3017 (Dsi/Beta-Delta) in the northwest quadrant have been the most significant regions on the visible disc, though both have not significantly flared in the past 24-hours, with only low-mid level C-class flare activity. AR3014 is a moderately large sunspot with a delta spot and beta-gamma-delta configuration. AR3017 has simplified in recent hours in respect of the intermediate spots between leader and trailer fading although a delta spot has formed on the rearward portion of this group, so will continue to be closely monitored in its evolution and potential for significant flaring. There are five further regions visible, with all of these simple unipolar or bipolar regions presenting very low flare risks.

Solar activity is expected to be mainly Low, but with a chance of increasing to Moderate with any M-flares that occur, and a very slight chance of X-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16/17 X-ray Flux



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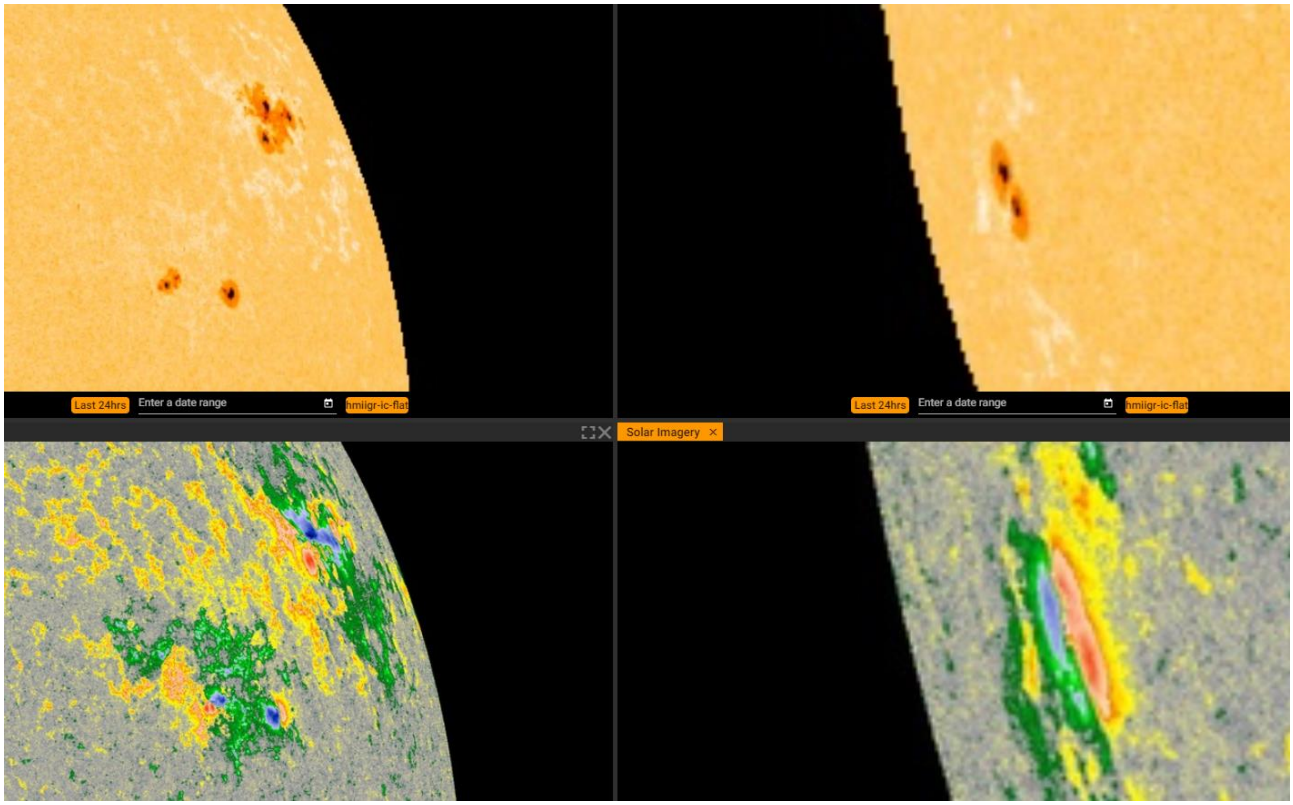
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period. There is a slightly increased risk of solar radiation storms through the next four days as regions AR3014 and AR3017 rotate towards the western limb, with this being the prime region for Earth-directed storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: AR3014 and AR3017 (left) and AR3023 (right) SDO Intensitygram and Magnetogram



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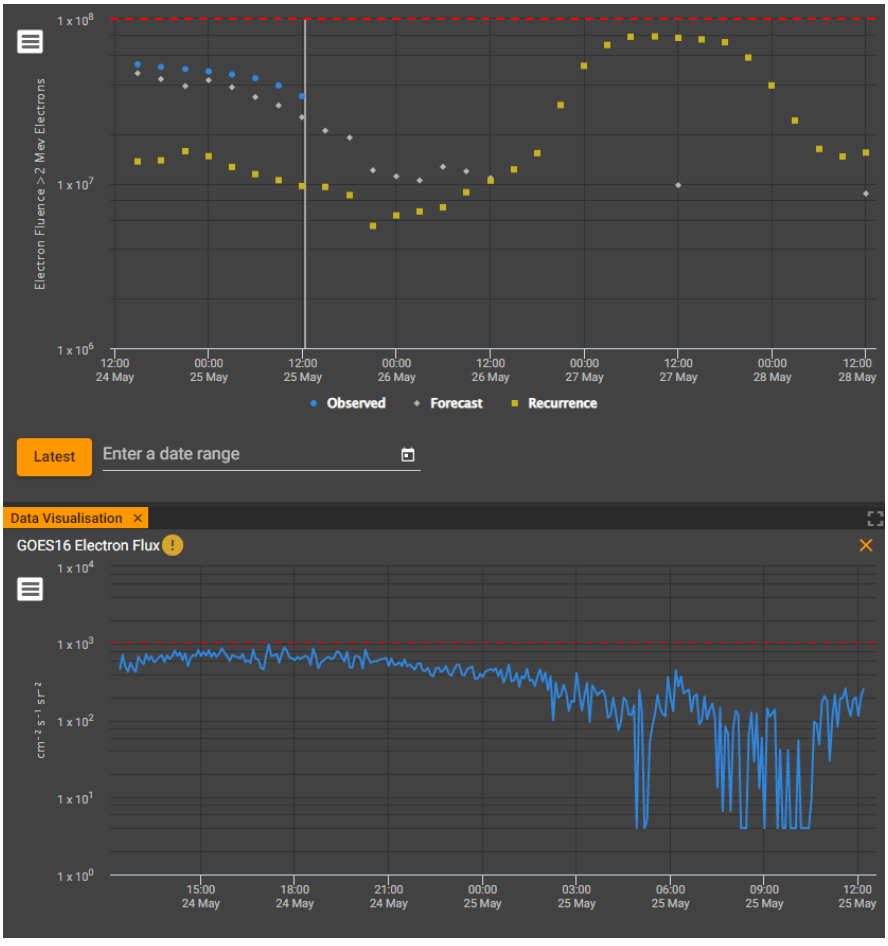
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has declined during the last 24 hours, with the latest peak lower than for the previous day. This trend is expected to continue for the next two days, with a more significant drop to background then likely on Day 2 (26th). A rising trend is possible from Day 3 (27th), but currently expected to remain below high (1000pfu) Electron fluence is now likely to have peaked for the period, with a declining trend through Day 3. A slightly rising trend is possible at the end of the period, but the Active (1e8 integrated pfu) threshold is unlikely to be breached.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 >2MeV electron Fluence with REFM (top) and Flux (bottom)



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